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AN
INTRODUCTION
TO
ARCHAEOLOGY

by

HASMUKH DHIRAJLAL SANKALIA

M.A., LL.B., Ph.D. (London)

*Professor of Proto-Indian and Ancient Indian History,
and Head of the History Department, Deccan College
and*

*Professor-in-charge, Department of Archaeology,
University of Poona*



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TO
ARCHAEOLOGY

Deccan College
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History of Man Series

1

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by
H. D. SANKALIA

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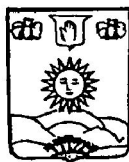
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Preface

THIS SMALL booklet is the first in the series entitled "History of Man", planned by the Department of Archaeology, University of Poona and the Deccan College.

The aim of this series, as mentioned in the preamble to the scheme, is to transmit the new knowledge acquired with the help of archaeology and sister disciplines to schools and colleges in India. For instance, during the last 20 years or so, various discoveries have been made in India and outside, which have taken back the history of man and his achievements in the past.

New Knowledge

For instance, the following new data have emerged :—

- i. the discovery of tool-making man in Africa, dated to 17 lakhs of years;
- ii. discoveries of Stone Age remains of men in several other parts of the world, such as China, Palestine, Iraq and Iran;
- iii. discovery of two widespread Stone Age Cultures in the whole of India;
- iv. discovery of the oldest town wall at Jericho (Jordan, old Palestine) of about 6000 B.C.;
- v. discovery of the remains of towns and villages in Turkey with traces of wall-painting going back to 5000 B.C.;
- vi. discovery of foodgrains such as wheat, lentil etc. in Turkey of about 5000 B.C.;
- vii. discovery of the extension of the Indus Culture to Gujarat, Saurashtra, Punjab, Uttar Pradesh and Rajasthan;
- viii. discovery of the port at Lothal, Gujarat, of about 2000 B.C.;
- ix. discovery of silk, cotton and flax, in Maharashtra of 1200 B.C.;
- x. discovery of extensive protohistoric (Chalcolithic) cultures in Gujarat, Maharashtra, Mysore, Madhya Pradesh, Rajasthan, Uttar Pradesh and West Bengal;
- xi. discovery of several foodgrains in Madhya Pradesh and distinctive pottery shapes of about 1600 B.C.;
- xii. discovery of a widespread pre-Asokan Culture (Painted Grey Ware) in U.P., Punjab and Rajasthan;
- xiii. discovery of the different types of Megalithic monuments in South India, including Kerala;

- xiv. discovery of temples, stupas, images, sculptures in hitherto unknown places and regions, such as Shamalaji (N. Gujarat), Udayagiri (Orissa), Akota (Baroda).

Hitherto all this new knowledge has been confined to excavation reports and some general, large-sized works, which are beyond the reach, not only of teachers in schools and colleges, but also that of research workers. This new knowledge has to be disseminated to other scholars as well. That is, it is necessary to take this knowledge to schools and colleges and thus to change the content of the present text books.

Means of Transmission

This may be done :

- i. either by writers whose books are today prescribed in schools and colleges—that is school and college teachers, or
- ii. by experts—that is scholars who are working in this field, and know the subject at first hand.

Seminar

Instead of leaving the work of conveying all this new knowledge to amateurs who do not know and even understand the subject (for very often gross mistakes are made in presenting the evidence), it has been thought advisable :

- i. to convene a meeting of select teachers from schools and colleges from each district of Maharashtra, and from all other States of India;
- ii. to place before them authoritative booklets written by experts, in a language they can understand (without at the same time changing the meaning or content of the subject).

Preparation of Booklets

The first necessity is to prepare a list of subjects on which the booklets should be written. Secondly, to get them published before the teachers are invited to a Seminar.

Four Series

The first, viz. the preparation of the list of subjects, has been done. A perusal of it will show that three points of view have been kept in mind.

Series I is meant to give a general knowledge of man's development throughout the world, that is, in areas or regions where it is best known.

Series II would deal chronologically with the general development of various aspects of civilization in India,

Series III is regional. Here it is intended to focus attention on the prehistory of each State, which has been brought to light during the recent years.

Series IV is subject-wise. Here the attention will be pin-pointed on certain items—such as the antiquity of iron, agriculture, clothes, etc. on which even the educated people in India have very vague ideas. People often cite the *Ramayana* and the *Mahabharata* forgetting that these epics cannot be precisely dated, and refer to the iron bow of Rama or cities like Taxila, as built by Bharata. Both these, in fact, are very late and show the late composition of these sections in the epics.

Booklets in every series will normally be of five thousand to ten thousand words. And the form of the book will be 24.5 cm. x 18 cm. The information will be accurate and concise, but presented in a non-technical language *as far as possible*. The aim is to present a readable and accurate account to a non-specialist.

In every series special effort should be made to indicate in *brief*—

- i. the world or general background;
- ii. the gaps in our knowledge;
- iii. the ways and means by which these could be filled up, so that the readers will form a proper estimate of the new knowledge offered to them, as also its limitations, and finally realize the importance of archaeology, and allied disciplines in the acquisition of this knowledge.

Special Features of the Scheme

A special feature of this Scheme, unlike similar schemes, is to offer something concrete to the participating teachers which each teacher can take back with him and pass on to his colleagues in his State.

It will also be possible to publish the material separately, as soon as the Seminar is over. Thus we shall have created suitable agencies for the dissemination of new knowledge.

Adaptation in Regional Languages

Another important feature of this Scheme is that once we have prepared authoritative versions in English, these can be adapted in regional languages without any difficulty.

Revision

Thirdly, if this Scheme is successful, then every five years, it can be reviewed and the booklets revised, if necessary. Thus all the new knowledge can be soon passed on to the teachers who are responsible for the future of new generations and our country.

LIST OF SUBJECTS

Series I: General

1. Archaeology—Its Meaning and Scope (Introduction to Archaeology).
2. Methods in Archaeology.
3. Man's Animal Ancestors.
4. Our Early Ancestors.
5. Early Man's Environment.
6. Primitive Food Gatherers.
7. Advanced Food Gatherers.
8. Beginnings of Settled Life (including agriculture and domestication).
9. Dawn of Civilization (Urbanization).

Series II: India—General Series

1. Geographical Background of Indian Archaeology.
2. Early Stone Age.
3. Middle Stone Age.
4. Late Stone Age.
5. Neolithic.
6. Antecedents of the Indus Civilization.
7. The Indus Civilization.
8. Chalcolithic Cultures.
9. Protohistoric India and Western Asia.
10. The Iron Age.
11. Megaliths.
12. Indian Archaeology and Primitive Peoples.
13. Prehistoric Art.

Series III: India—Regional Series

1. Pre-and-Proto Historic Jammu and Kashmir.
2. Pre-and-Proto Historic Punjab.
3. Pre-and-Proto Historic Rajasthan.
4. Pre-and-Proto Historic Gujarat.
5. Pre-and-Proto Historic Madhya Pradesh.
6. Pre-and-Proto Historic Uttar Pradesh.
7. Pre-and-Proto Historic Bihar.

8. Pre-and-Proto Historic Orissa.
9. Pre-and-Proto Historic West Bengal.
10. Pre-and-Proto Historic Assam.
11. Pre-and-Proto Historic Maharashtra.
12. Pre-and-Proto Historic Mysore.
13. Pre-and-Proto Historic Andhra Pradesh.
14. Pre-and-Proto Historic Madras.
15. Pre-and-Proto Historic Kerala.

Series IV : India—History Series

1. History of Agriculture.
2. History of Domestication of Animals.
3. History of Houses and Habitations.
4. History of Pots and Utensils.
5. History of Food.
6. History of Clothing.
7. History of Town Planning.
8. History of Disposal of the Dead.
9. History of Communications.
10. History of Grinding Stones.
11. History of Fire and Fuel.
12. History of Weights and Measures.
13. History of Metals.
14. History of Furniture.
15. History of Writing and Writing Materials.
16. History of Numerals.
17. History of Medicine.
18. History of Ornaments.
19. History of Weaving and Basketry.
20. History of Terracotta Figurines.
21. History of Glass.
22. History of Temples.
23. History of Magic and Religion.
24. History of Forts and Fortification.
25. History of Arms.

26. History of Coins.
27. History of Beads.
28. History of Paintings.
29. History of Sculpture.
30. History of Iconography.
31. History of Bronzes.
32. History of Tribal Art.
33. History of Musical Instruments.

Contributors

Invitations have already been extended to a large number of scholars. If these scholars fulfil their promise given while accepting the invitation, then it is hoped that it will be possible to send to the press at least 50 booklets by the first week of December 1965.

Thus when the Seminar is held in May-October 1966 it is expected to publish a major portion of the projected booklets.

Illustrations

Since this booklet illustrates several ways by which archaeology contributes to the knowledge of man's past, a few more illustrations—line as well as half tone—have been included in it, though normally each booklet will carry about 2 pages of illustrations only.

Publication

The advance publication of this booklet has been made possible by munificent grants by Sir Dorabji and Ratan Tata Trusts. I am therefore extremely thankful to the authorities of these Trusts, and particularly to Sir Rustom MASANI and Professor R. D. CHOKSEY.

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I must thank Mr. J. JACOBSON of the University of Columbia, U.S.A., as well as my colleagues in the Department—Dr. Z. D. ANSARI, Dr. S. B. DEO, Dr. M. S. MATE, Dr. V. N. MISRA, Dr. G. G. MUJUMDAR and Shri S. N. RAJAGURU for their suggestions with a view to making the booklet useful. Our Library staff was most co-operative. Figure 17a—a terracotta boot—I could add at the last minute when Shrimati Madhuri INGALGAONKAR sent me the latest issue of the *Artibus Asiae* and our photographer Shri V. K. NAGPURE promptly prepared a print from it. The Draftsmen, Sarvashri S. K. KULKARNI and Y. S. RASAR have made the line drawings, and the chart which shows how archaeology helps in the reconstruction of the History of Man with the help of Humanities and Sciences.

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I

ARCHAEOLOGY

A R C H A E O L O G Y is generally understood to be a subject which deals with the study of antiquities. This not only includes the collection of old objects made by man, but the various methods to search for old objects, and the attempts to reconstruct the history of past events by the study of objects or things so collected. Archaeology, in brief, is the pursuit of the history of man.

STREET COLLECTOR AND ARCHAEOLOGIST

This is a very broad, all embracing definition of archaeology. But for such a point of view, there would be no difference between a street collector of old things and an archaeologist. Between a street collector and an archaeologist there is another important, nay vital difference. A street collector roaming from house to house in a city like Bombay collects old tins, lamps, vessels, clothes, newspapers etc., in a haphazard manner. He has little interest in the work of collection, nor in the objects he collects, except their likely monetary value. An archaeologist, on the contrary, is interested in collecting everything in his search, and above all takes delight in his work. The search becomes a hobby.

This change in the outlook on archaeology has come in during the last 100 years. During the early days in the development of this subject collectors, even scholars, were interested only in the collection of old coins, inscriptions and sculptures which were valuable and/or beautiful. Later, it was realized that the joy or delight lay not merely in the collection of beautiful or valuable objects, but in the "story" of man which lay behind the object and its context.

DETECTIVE

Looked at from this point of view archaeology at once becomes a very fascinating subject. For, there is little difference between an archaeologist and a detective. In fact, the former encompasses a much wider field.

Such an all embracing definition of archaeology would then include not only large and outstanding monuments, or precious objects of gold, silver, pearls, and diamonds, but such worthless things as ash, earth, ordinary stones, bones of men and animals, nay even their dried up or fossil faecal matter (coprolite).

AIMS AND OBJECTS

What then are the aims and objects of archaeology which was hitherto defined as the search and study of antiquities?

HISTORY OF MAN

The aim is the reconstruction of the history of man, from the time man first appeared on this earth. In such a study everything associated with man is included. Thus we study not only man and things or objects made by man, but the history of past or ancient climate, astronomy, geography—such as the rise and fall of sea beaches, land bridges between continents, the formation or disappearance of deserts, changes in river beds—as well as agriculture, metallurgy, the art of making pottery, weaving, spinning, clothes and clothing materials (such as cotton, silk, flax), houses and materials for house-making, the nature of habitation, density of population and communications.

TRADITIONAL HISTORY

In all these, the traditional histories—the record of dynasties and kings, and their wars which hitherto formed the main content of school and college courses—would seem to form a very small or insignificant part, not even one hundredth.

HUMAN HISTORY

Such a study which goes to the root or foundation of things connected with man, we shall call human history. In its reconstruction archaeology forms a leading and important part.

ARCHAEOLOGIST'S EQUIPMENT

A student of archaeology should be well-versed not only in history, geography and such subjects as history of architecture, sculpture, iconography, numismatics, and palaeography, but should have an elementary knowledge of, or should be prepared to acquaint himself with the necessary knowledge of physics, chemistry, geology, botany and zoology. Unless an archaeologist is so prepared he cannot fully appreciate the significance of various things he finds or comes across during his search and would thus miss the opportunity to reconstruct the "story" from his "finds" or discoveries.

PARTICIPANTS

This does not imply that only highly trained professionals can search for old or ancient objects. This subject is such that even a child of five or a man



Fig. 1 See p. 6.
Mound, Sisupalgarh,
Orissa.



Fig. 2
*A mound at
Rangamahar
in Rajasthan.*

In this figure is shown what an artificial mound—as opposed to natural mound or hill is. Not only it shows considerable swelling in the general, flat, level of the ground, but its surfaces, particularly the slopes, are strewn with potsherds (broken pottery). This feature is best illustrated in Western and Northern Rajasthan, where an artificial mound can be easily detected from the mass of sandy hillocks and plains.



Fig. 3 *Air view of an ancient site in Orissa* See p. 19.

This photograph taken from the air distinctly shows the fortification around the ancient city of Sisupalgarh in Orissa, built some 2,000 years ago.

Fig. 4

Trunk

See p. 19.

This is an illustration of a well arranged trunk. At the very bottom have been placed small boxes, round and rectangular. In the intermediate layer are placed a bottle and clothes. And right on the top are placed a shirt, a pair of scissors and purses, etc.

Now if the various objects are removed carefully *one by one*, then one knows how and where the round box was placed. This is a most simplified illustration of a careful, scientific excavation.

Fig. 4a

Excavation

See p. 20.

This figure illustrates a stratigraphic excavation and shows further how an object is dated on the stratigraphic evidence.

It is generally believed that the deeper an object is found, the older it is likely to be. According to this belief, all objects below layer 6—vessels, foundations of houses—should belong to the same period.

Now the pots (clay vessels) in layer 7 have been proved to be nearly 3,000 years old, of c.1000 B.C., whereas the vessel shown with a cross is only of 100 A.D., that is about 1,800 years old.

How has so much difference in time taken place? If we examine the section carefully, it will be found that the standing vessel with a (X) has been kept at the foot or bottom of a well. This well has been dug from layer 2. However, superficially, it would appear that the vessels placed mouth to mouth at a depth of 8 ft. and this standing vessel, all belong to the same period.

This observation can be made only by a trained excavator.

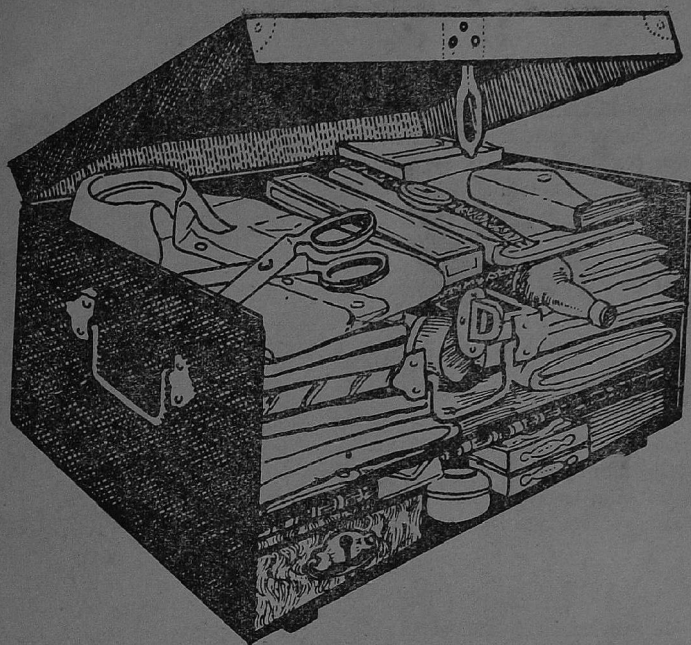


Fig. 4

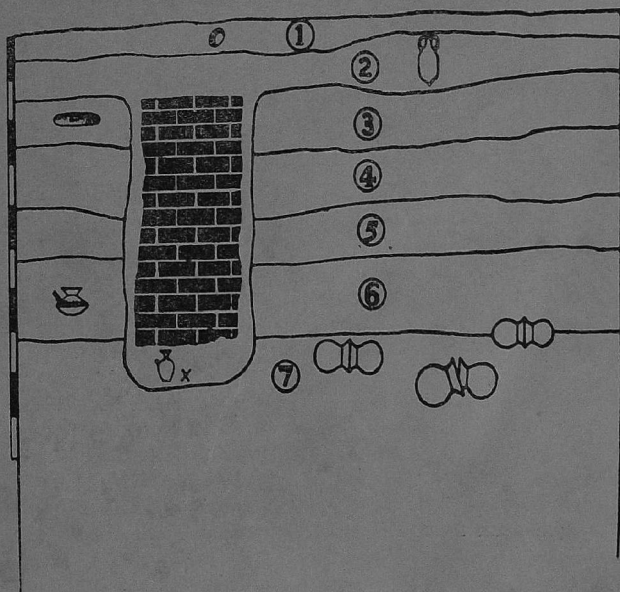


Fig. 4a

or woman of 75, educated or uneducated, rich or poor, without distinction of caste or colour, can participate in its various activities. Of course, every individual will contribute according to his or her age, general education and several other factors. But such limitations exist in all subjects.

DISCOVERIES

Archaeological discoveries are made in various ways. But in the main, there are two. The first is the search for objects lying on the surface. The second is a systematic recovery of objects buried in the ground by a careful excavation.

SURFACE OBJECTS

The objects on the surface at a particular place might either belong to that place or might have been brought there. In either case, their existence definitely indicates the presence of man at that place. There is also a third way by which objects might be brought at a place. For instance, man-made objects—artifacts—might be carried and deposited at a place by a river in flood. This will suggest the presence of man in an indirect way.

MOUND

(Figures 1, 2)

If man remains or lives at any place for a pretty long period, then gradually a mound is built. A mound is an artificial hillock. Usually it is formed by the accumulated debris of various habitations. Whenever houses are destroyed by any means, and if the debris—brickbats, stone rubble or lumps of clay—are not cleared away, and if the subsequent habitations are built by levelling the former debris, then slowly the level of the habitation rises. And when these are excavated by archaeologists, they find remains of structures of various periods. Ruins of temples, mosques and stupas as well as towns and cities are thus preserved as mounds.

KITCHEN MIDDENS OR REFUSE HEAPS

Small mounds have been formed in street corners in larger cities and on the outskirts of villages wherever there has been no efficient municipal sanitary department. These refuse heaps or kitchen "middens", have yielded important evidence (in countries like Denmark) of the man's way of life thousands of years ago. And even today such garbage analysis will throw light on some aspects of our life, if all other records are destroyed or become non-existent for some reason or the other. Flourishing cities, Babylon and Mohenjodaro, for instance, once destroyed, turned into mounds, and remained hidden for thousands of years. A traveller, a scholar or an explorer, might chance to see these mounds. Not only their imposing height but stray objects like potsherds, coins, beads and images, would catch his eye, as these lie exposed, on the surface of the mound or in crevices formed by the action of natural agencies like wind and rain. An ancient object is thus found. This arouses his curiosity. Now begins a systematic search.

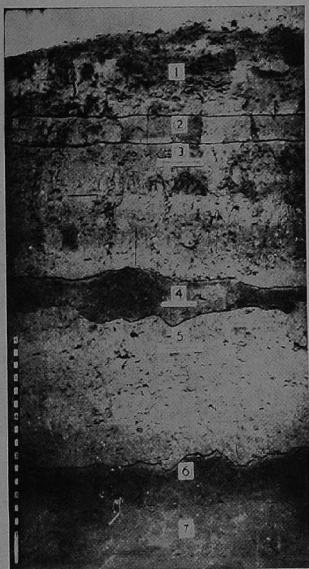


Fig. 5

See p. 20 and p. 27.

Vertical Excavation

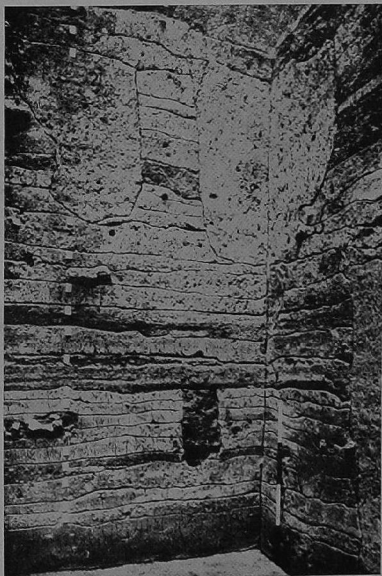
View of the wall of an excavated trench in the mound at Nevasa, showing the deposits (debris) of various periods shown as layers. Note particularly the black colour of layers (1), (4) and (6).

Fig. 6

See p. 20.

Vertical Excavation

Vertical excavation, showing later disturbance (by pits) at Ujjain.



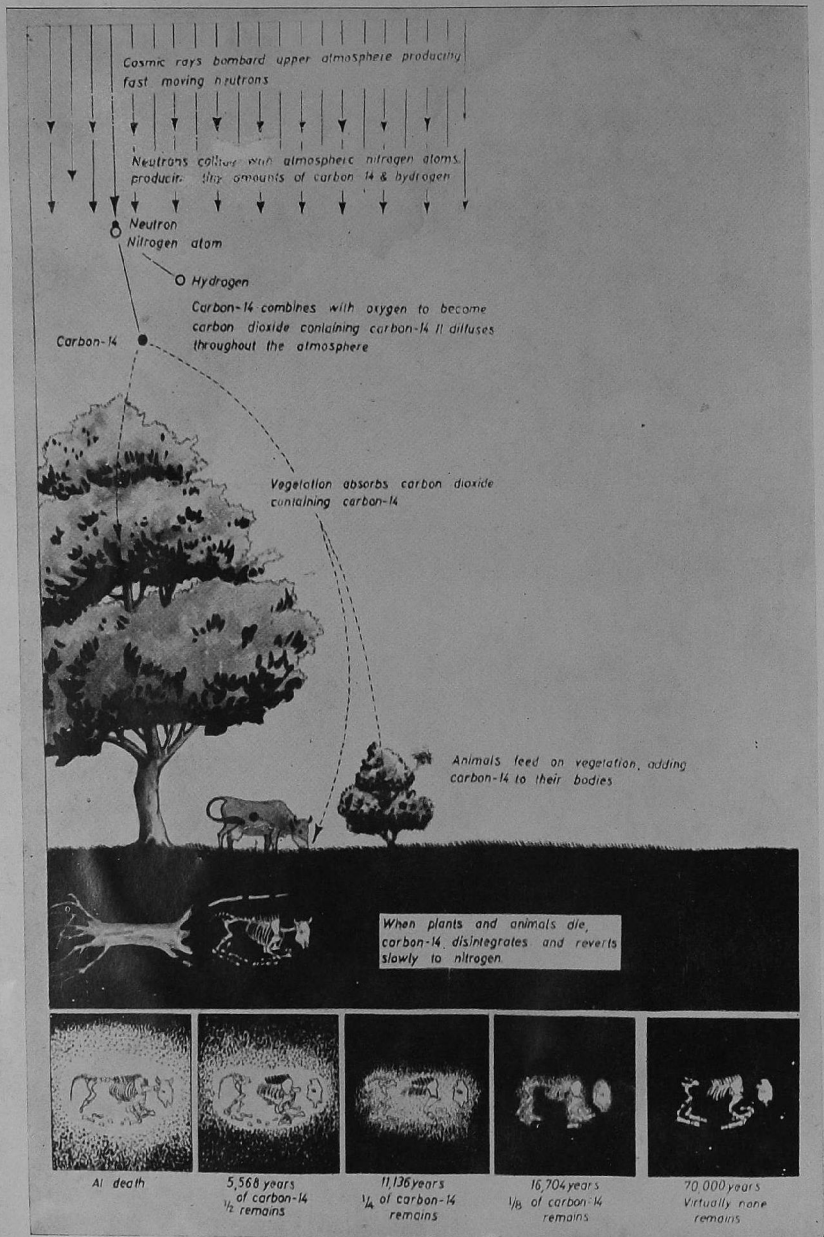


Fig. 7 How C-14 method works. This explains the principle of C-14 method. See p. 21.

Fig. 11

See p. 24.

*Female figure (terracotta) of
Sunga Period*

(c. 100 B.C.)

The figure is heavily decorated with ornaments. A study of these ornaments will give an idea of the fashions in India some 2,000 years ago.



Fig. 11a

*Terracotta boot vessel from Kultepe, Turkey c. 19th century B.C.
(about 3,765 years ago.)*

Normally terracotta figures represent men, women, animals, birds. This terracotta is unusual. It stands for a boot. Though it was probably used for libations, still for our purpose, it illustrates the antiquity of boots. There is no doubt these and other type of boots and shoes with upturned toes which we nowadays find in Rajasthan can be traced back to Western and Central Asia. Courtesy: *Artibus Asiae*, Vol. XXVII, p. 69, Fig. 8.



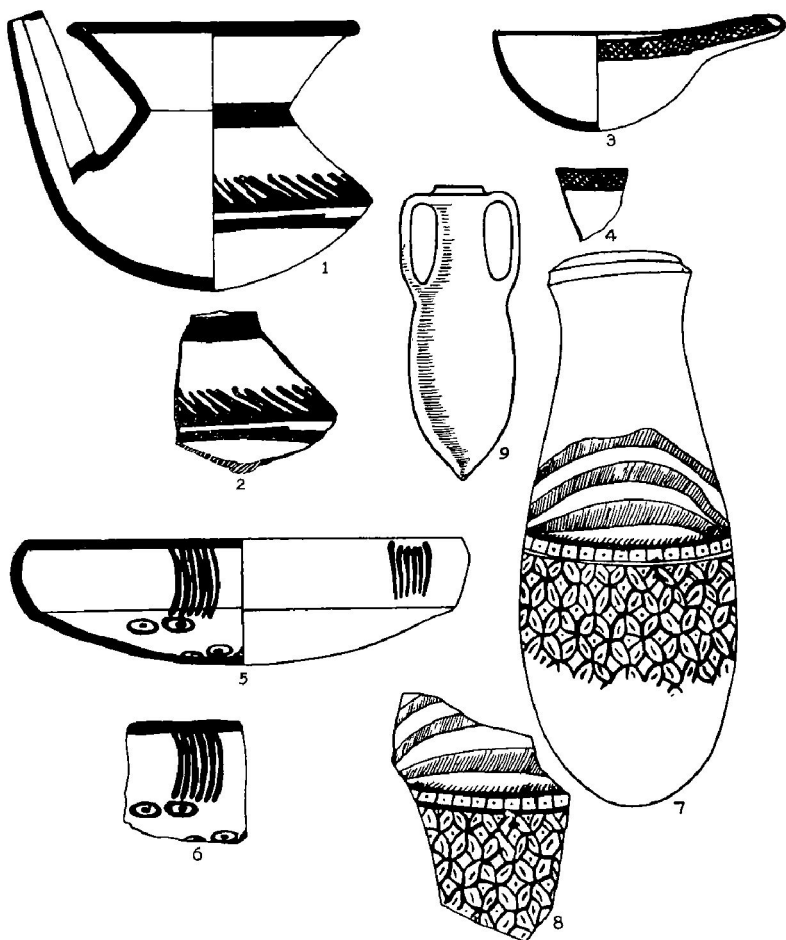


Fig. 12

See p. 24.

Pottery Types

These

This figure shows some pottery vessels and their fragments (potsherds) from the excavations at Nevasa (Maharashtra) (1-2), Navdatoli (Madhya Pradesh) (3-4), Hastinapur (Uttar Pradesh) (5-6), Lothal (Gujarat) (7-8).

No. 9 is an amphora, a pottery vessel used for storing olive oil/wine in the Roman world. Specimens of the amphora are found in many cities all over India, e.g. Nasik, Kolhapur, Nevasa, Dwarka, Ujjain. The amphora has a pale-yellowish, compact fabric, and anyone who has once handled it can never forget it.

(Contd. on next page)

Fig. 12

The vessels from Nevasa have a dark red background and paintings in black. Those from Hastinapur have paintings in black over an ashy grey background. While the vessels from Navdatoli and Lothal have a peculiar shape, as well as fabric and decoration, which is generally in black over a red surface.

Now all these are quite different from the modern, simple black or red, pottery vessels. Therefore when potsherds of the Nevasa, Hastinapur, or amphora type pottery are found on a mound, they naturally indicate the existence of an ancient site like Nevasa or Hastinapur.

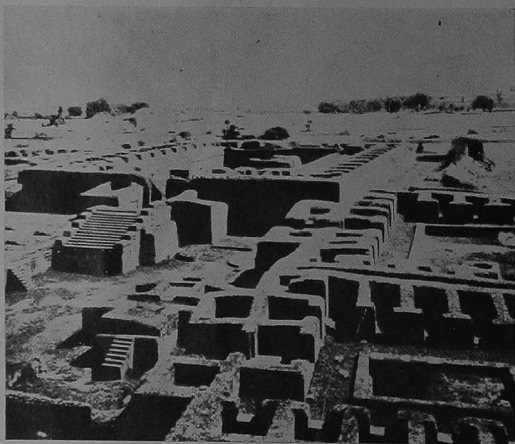


Fig. 13

See p. 25.

Houses (Nalanda Monastery)

The photo shows the remains of the monastery at Nalanda, Bihar. Note the well, easy-paced staircases on the left, and the row of rooms on the right foreground.



Fig. 14

Ancient House

This shows two sides (walls) of a mud-built house with broken pots, c.1200 B.C. Navdatoli, opposite Maheshwar, M.P.

Fig. 15

See p. 25.

Painting

This shows how earthen pots were painted in ancient times at Daimabad, Dist. Ahmednagar c.1200 B.C.

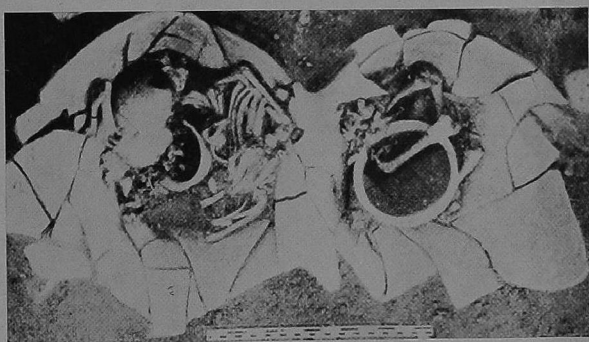
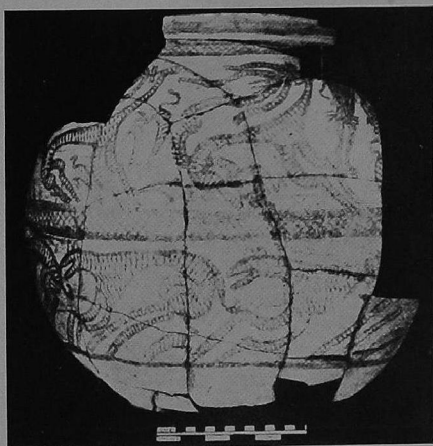


Fig. 16

See p. 25.

Burial, Nevasa, c. 1200 B.C.

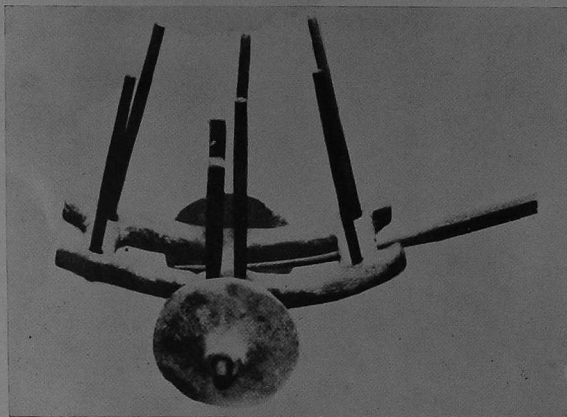
This photograph illustrates the method of burying a dead child in two earthen pots. It also shows two small vessels; one pot on the left, and the other on the right with parts of the skull put in the vessel.

Figs. 17, 18

See p. 26.

Toy cart from Mohenjodaro and a modern cart in Sind

Of this Toy cart, only the frame and the wheels—both made of clay—were found. The sticks have been inserted later.



It is interesting to note that for all these 4,000 years and more, the cart design has not changed in Sind.

Keen and careful observation not only enables him to collect many more objects, but even the character of the site is sometimes revealed. A discovery is made.

CHILDREN

Now anyone — even an old man or a child — can or may make such observation and discoveries. What is needed in the beginning is curiosity, power of observation and patience. As artifacts or objects are found, so the interest is created and the person begins to ask himself, "What can this be?" "How old is it?" Children have curiosity, the power of observation, and also have the tendency to collect objects. All these qualities can be further cultivated if they are introduced to archaeology. The subject itself will or might benefit in future, but at the moment the child's curiosity and power of observation are developed. And more important, a hobby is formed.

PREHISTORIC TOOLS : GOLF GROUND

These statements are based on my own experience. To the east of the Deccan College campus is the extensive undulating golf ground. During my daily morning walk on this ground, I occasionally noticed stone tools resembling small knife blades. One day, I was surprised to find a paisa-like coin of silver, about 2000 years old. And I wondered to myself, "How did these stone tools and coin come to be here? Is it possible that man once lived on this grounds? Soon after, a beautiful small stone tool was discovered in the compound of my bungalow. Now in all bungalows in Poona, a fine sandy gravel is spread in the compound. Similar gravel is also spread on the golf links. Hence I inferred that tools must have been brought with the gravel. Next day I inquired of the man who prepared the links the source of these sands. And he told me that the gravel was usually brought from Koregaon, a village 16 miles north of Poona on the river Bhima. Examining the river sand at Koregaon, hundreds of stone tools were discovered. And a mound indicating the existence of an ancient habitation was seen overlooking the river, though neither Koregaon villagers nor the citizens of Poona are aware of the fact that they live near such a 3,000 year-old-site.

Next, I taught the children of a friend how to look for such stone tools in their compound. Their curiosity was aroused. They took interest in this subject. And very soon these children began to find objects thousands of years old.

However, all surface sites are not discovered so easily. Very often legends, traditions, old accounts, diaries of travellers have to be consulted and examined before a search is begun.

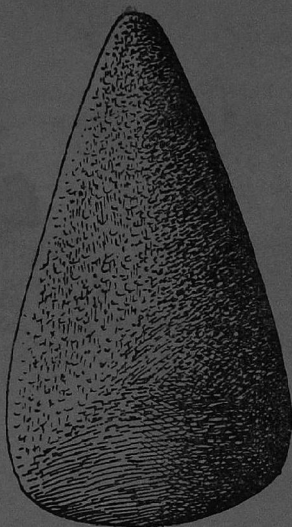
POTSHERDS

(Fig. 12)

In such a search, potsherds (pieces of broken pottery) play a very important part. As a rule, wherever man has lived in India for the last 5,000 years, some such potsherds are found (though nowadays, in these days of copper, bronze, stainless steel, plastics and Dalda tins, such potsherds will certainly become scarce).



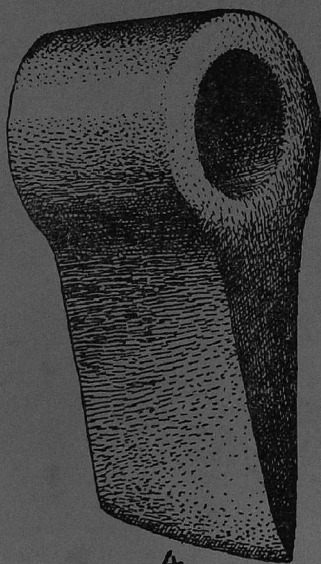
1



2



3



4

Fig. 19

Axes through the Ages : Stone to Iron

See p. 26.

Fig. 19

See p. 26.

In this figure are illustrated four typical tools.

No. 1 is of stone, made with the help of another stone. Note its broad cutting edge and narrow back (butt). Early Stone Age. c.1,00,000 years ago.

No. 2 is of stone, made with the help of another stone. Its edge as well as the body is made smooth by grinding. Neolithic or New Stone Age. c.4,000 years ago.

No. 3 is of copper/bronze, and is found without socket in India. c.3,000—4,000 years ago.

No. 4 is of iron. c.2,000 years ago. Note the socket, a device for inserting a wooden handle, was discovered some 5,000 years ago in Mesopotamia.

Fig. 20

See p. 29.

Charred grains

This figure illustrates raw charred grains of Wheat (W), Rice (R), Udid (U), Peas (P), Mung (M), and Gram (G) as well as Beans (B) and Berry (Br) from the excavations at Navdatoli.

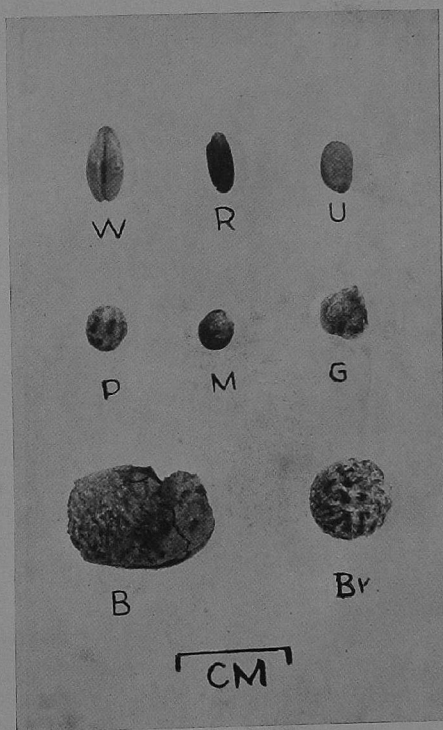




Fig. 21

See p. 29.

Marine Excavation and Photography

Cutting a cargo-filled lump from the concretion on the bed of the Mediterranean sea lying just off Cape Gelidonya, in south-west Turkey. (Courtesy: *Marine Archaeology*, Fig. 15).

Pottery, that is vessels of clay, once they are well baked in fire, have the quality to endure for ages. They are almost deathless. Though exposed to the sun and rain for thousands of years, they neither lose their form, nor the slip (thin coating of colour) or painting over it. Hence pottery or potsherds are the best indicators and preservers of many ancient cultures and civilizations.

AERIAL SURVEY

(Figure 3)

Exploration, that is the search for new sites, is also done from the air. Landmarks such as former village or city boundaries, forts and moats, even limits of fields, can be discovered by aerial photography, usually during mornings and late evenings when the shadows are long. During the last 40 years scores of sites have been discovered in Europe and Asia. And only a few years ago Pakistan planes, under the direction of Sir Mortimer Wheeler, succeeded in discovering the remains of the Indo-Greek city at Bala Hisar, near Charsada. Similarly an air-photograph revealed the outlines of an ancient fortified city—Sisupalgarh in Orissa.

ARCHAEOLOGICAL EXCAVATION

Precise dating of surface finds is rarely possible.

To decide the age of the object and the site—a small or large excavation is necessary. This excavation is of a different nature than the excavation done by the P.W.D. or house-builders, or those who construct huge dams.

An archaeological excavation is a very slow, systematic affair, that is more a scientific investigation than a treasure hunt.

Its main aim is to discover evidence—an object, in the form of potsherds or building, after making a full record of its occurrence in the earth. Such careful notes can be made only when the archaeologist himself is present on the site, and the work of digging is done under his personal supervision. Before an object is removed from the excavated area—trench or pit—he has not only to pin-point the exact place where the object lay by three dimensional measurements from a fixed point in his trench, but he has to observe that the layers above the object are not “disturbed”, that is, that the object belongs to the layer where it has been found. When the object's position is shown in a measured drawing (plan as well as section) any one seeing it can have an idea of the relative age of the object, as well as some idea of its position in the story the excavator may unfold.

UNPACKING A TRUNK

(Figure 4)

Let us imagine ourselves detectives searching for clues in a well-packed trunk. We can remove an object from the trunk either by ransacking it in a hurry or putting our hand here and there, or by carefully and slowly removing first

objects placed on the top layer, then those lying in the 2nd layer and in the next, and finally we reach the objects kept at the bottom.

INTENTION OF THE PACKER

While we may succeed in finding some objects by ransacking the trunk, still we shall never know how the trunk was packed by its owner, and why a certain object was placed at a particular place. But by slowly unpacking it, we understand the entire process of packing, and also the value or the importance the person attached to an object when he kept it at a particular place, say between the folds of two plastic sheets. Thus we enter the mind of the packer, and that is what a true scientific excavation is expected to do, to delve deep into the past and not only unfold its secrets, but lay bare, step by step, the processes by which objects find their way into the earth.

VERTICAL EXCAVATION

(Figures 4a-6)

This is a very simple illustration of a scientific excavation. A pit or trench limited in area but of considerable depth is referred to as a vertical excavation. This may provide little information beyond the relative age of the various objects recovered. But if the excavation is sufficiently broad or extensive, then the house plans or the burials may be laid bare, thereby revealing the fuller significance of the finds.

SIGNIFICANCE OF DEPTH

Normally, it is a common belief even among educated persons that the deeper the object found, the older it is. Thus in an excavation about 10 ft. deep, the object at the depth of 8 ft. would be regarded as older than the one at a depth of 4 ft. But this would be so only if there is no disturbance. That is, none has dug a pit, say from the present level of the ground; and thrown the object (a Naya paisa, for instance) or placed it at a depth of 8 ft. How can we know this? It is not difficult. When a man digs a pit and subsequently fills it up either with the same earth or an earth of different colour and texture, this part of the ground is always *comparatively* more loose than the adjoining undisturbed or undug area. A careful excavator will immediately feel and see both by the touch of his knife and his eye this difference and he can detect the "pit". Slowly as a detective, he follows the line of the pit and finds out from what level of the ground this pit is dug. Soon the secret is out. It becomes more easy to detect the pit, if it is filled by a different soil or earth. Thus the most important thing in an excavation is to see that the object—pot, ornament, or human skeleton—is lying in an undisturbed condition, exactly as it lay there or was placed there when man lived at that level of the ground.

Let us proceed further. Suppose we ascertain that the object at a depth of 8 feet is lying in an undisturbed state. Then we can certainly say it is older than one at 4 feet. This is a simple example of relative dating.

Now if the nature of the soil, colour, compactness, etc., is also different than that of the soil at 8 ft., we say further that the two layers are different and formed at different times. Thus we have one more clue indicating that the object at 8 feet depth is older than that at 4 feet depth. For not only it is at a greater depth, but lying in a different layer.

STRATIFICATION

This is the principle of layers or stratification introduced in geology by Sir Charles Lyell in 1833 and increasingly adopted by archaeology.

After ascertaining the relative dates of two objects, we have to take the next step, viz to know the absolute date or date in years or chronometric date.

Hitherto it was possible to know the absolute or chronometric date, if an object of known date was found. Thus if we found a coin of a king whom we knew from written records ruled in 100 A.D. or still better an object made at this time, from the layer above the object at 8 ft. depth, then we could say that all the objects including structures, found at this depth, dated from no earlier than the 2nd century A.D. But this, at best, is again an instance of relative dating. What was wanted was a purely objective method of dating.

C-14 METHOD OF DATING

(Figure 7)

The age in calendar (solar) years is now being obtained by several methods, besides the older ones based on dated coins and inscriptions. Of these the C-14 method has so far proved to be most useful, particularly for a range of time going back to some 70,000 years. It is based on cosmic rays and radio-activity with which any living thing on this earth is charged with. The details have been explained elsewhere by me. It may be added that the measurement of atomic radiation called activation analysis is used in crime detection and delving into the unsolved mysteries of history. Even a single strand of hair is sufficient for activation analysis. Scientists at Sweden's Royal Institute of Technology proved by this method that their XVIth century king Erik XIV was murdered, whereas Dr. Hamilton Smith of Glasgow University carried out tests on the hair of Napoleon Bonaparte. This confirmed that Napoleon had been in some way exposed to arsenic during the last four months of his life. Further tests showed that the arsenic must have been administered before Napoleon was exiled.

II

So far we have described very briefly how an archaeologist makes 'initial' discoveries. The methods most often employed are exploration followed by excavation.

INTERPRETATION

Once the objects are found, starts the process of interpretation. This again is like the work of a detective; the greater the interest one takes in one's work, the more and more detailed history of the object and the site where the object was found, one is able to discover.

As mentioned earlier (p. 2), there is no remnant of the past which does not require the attention and study of the archaeologist, for a full and as complete a reconstruction of the story as possible. The instances cited below are merely illustrative and do not exhaust the entire field.

We cannot do better than start with the narration of the antiquities which were the first to help in unravelling the past history of India.

COINS AND INSCRIPTIONS

(Figures 9, 10)

Both coins and inscriptions have enriched the history of India, particularly the Early period, ranging from about the 4th century B.C. to the 6th century A.D. Of this vast period, we had had no written records as in Greece and Rome, except the accounts in the Puranas. It was a Dark period. Suddenly it began to be lighted when the coins which had been in Greek and Kharoshthi or Brahmi began to be deciphered. The story of this decipherment is indeed fascinating. It reads like a detective novel. It was the work of a young Englishman, James Prinsep. Though not a student of Sanskrit or Pali, he was intensely interested in antiquities, such as coins, inscriptions, and monuments of India. Possessed of a scientific mind, he found by collating, that is comparing letter by letter, the copies of five pillar inscriptions of Asoka, that their texts were identical. Later Prinsep found that the texts of these five inscriptions were again identical in many respects with those of the rock edicts at Girnar, Junagadh (Saurashtra) and Dhauili (Orissa).

He next found that some of the letters in these inscriptions were similar to those on coins of Greek kings who ruled in Afghanistan. These coins also bore the names of these kings in Greek letters. And since many early Europeans

knew Greek they could easily read these names. The next step in the decipherment was not difficult. Prinsep placed the Greek names and the Brahmi names side by side to determine the sounds that the Brahmi letters represented. He thus got the key, as he himself says, to unlock the secret of the Asokan inscriptions. Slowly most of the clear, legible portions of these inscriptions were read. An equally important discovery of Prinsep was the finding of the name of Greek (Yavana) king Antiochus Maga, and Ptolemy in the Girnar inscription. These not only helped him to date the inscriptions, but put Asoka, the Mauryan king, on an international plane. Prinsep was also not slow to realize the importance of the study of ancient scripts—palaeography—for dating not only records, but also other associated objects, particularly monuments. What newer disciplines like the C-14 method of dating are claiming today, viz. a chronometric dating, Prinsep claimed in the following memorable words :

“Having thus recovered the complete, and as I consider it, the primaeval alphabet of the Indian languages, I have arranged in the accompanying plate the changes each letter has undergone in successive centuries, as deduced from absolute records on copper or stone. The table furnishes a curious species of palaeographic chronometer, by which ancient monument may be assigned with considerable accuracy to the period at which it was written, even though it possesses no actual date”. (*Essays on Indian Antiquities of James Prinsep*, Ed. by Edward Thomas, Vol. II (London, 1858, p. 39).

SKELTON HISTORIES OF FOREIGN DYNASTIES

How true his estimate of this discovery was we all know when in the absence of stratigraphical evidence or other evidence, we all fall back upon palaeographical data.

Acting on these clues that skeleton histories of various dynasties like the Sakas, Kushanas and Parthians which ruled in the north-west frontier of India and the Punjab, Saurashtra and Central India were reconstructed.

The study of Brahmi itself is very interesting. During the course of 2,000 years it has developed in various ways. Brahmi is in fact the mother of almost all the current Indian scripts, except the Arabic.

ARCHITECTURE

The study of ancient Indian architecture is equally old. Nobody, whether he be a soldier or civilian, would fail to be struck by the huge rock-cut caves and temples of Ajanta, Ellora and Elephanta. The ruins of stupas and temples would be equally impressive, though when first discovered they would look like round or conical mounds. During the last hundred years and more, literally scores of such monuments have been discovered. Some may still be hidden in forests and unknown, as a large group of temples at Polo in Northern Gujarat or in Goa. Those known have proved to be an important source for understanding the

development of architecture, sculpture, religion and social customs, institutions, and cultural diffusion.

SCULPTURE

In India, sculpture rarely formed an independent course as an art form. From an early period it served architecture; pillars, walls and niches of stupas and temples came to be decorated with figures of gods, goddesses and semi-divine figures. All these figures as well as others which were separately worshipped, have a story to relate—about their origin, and form. This study forms part of iconography.

But these figures also provide data for preparing histories of dress, hair style, ornaments and other aspects of culture in ancient India.

All these—coins, inscriptions, sculptures, images, temples, stupas, mosques and minarets—were first found on the surface without a regular excavation. They are therefore called surface monuments.

EXCAVATION

Later when excavations were undertaken other things began to be found—remains of houses, at times with wall paintings; sometimes entire blocks of cities with lanes and roads and household things such as vessels of clay and stone, toys, ornaments, tools and weapons of copper and iron and burials. Everyone of these calls for detailed, careful study. Thus one may specialize in the study of ancient glass, ivory, beads, pottery and the like. Thus everything is important, but nothing so important as the study of pottery.

POTTERY

A reference was made above to the indestructibility of pottery. Not only it is indestructible, it has proved to be one of the best indexes of cultural changes in a society.

EXAMPLES

(Figure 12)

A few examples will illustrate this point. Today, pottery has lost its importance in our life because vessels of copper, bronze, stainless steel and plastic have replaced this household object. Nevertheless, it is still a recognizable cultural element with rather well-defined limits in time and space. Over 90 per cent of the people in Bombay, Poona, and several cities as well as villages use only two or three types of red or black earthen pots for storing drinking water. The shape, fabric and colour are very stereotyped because our society does not encourage variety, in fact does not very much need these pots. Hence, the potter goes on making year after year the same monotonous shapes. I have been seeing this for the last 50 years. Probably

these are being made since the last century or more. Thus these pots have a life of at least 100 years and since spread over many parts of Maharashtra, we may call it Maharashtra or Bombay pottery of the 20th century.

Now going backwards in time, we know that the pottery styles and preferences have constantly been changing. Thus after the 13th century, we find what is called China ware or glazed pottery. Recently many intact vessels of China were bearing a Chinese monogram were found in an old quarter of Ahmednagar. Two thousand years ago, all over Andhra, Mysore, Maharashtra and Madhya Pradesh, for eating and drinking people preferred dishes (thālis), bowls (vatis) and small water vessels (lotās), which were black on the top and red at the bottom, just as for the last few years we have taken to dinner sets of stainless steel. Earlier still, there was more variety in the shapes and above all, even the vessels of daily use, such as bowls, cups and water vessels as well as plates were painted and decorated with designs. Thus a graph of Indian pottery through the ages can be very revealing. And by a careful study of a detailed graph or series of graphs and correlating this information with other data, changes in the social and economic fabric of our society can be traced.

HOUSES AND HABITATIONS

(Figures 13, 14)

Excavations when on a large scale often uncover plans of houses, villages and cities. The best examples so far are provided by the excavations at Mohenjodaro, Harappa and Taxila, all now in West Pakistan. Within India, excavations at Nalanda, Bihar have revealed the remains of huge monasteries (residential houses for monks), while at Navdatoli (Madhya Pradesh) plans of several round and rectangular structures, all dated to c. 1500 B.C. have been exposed. A systematic study of all these (as shown in a separate monograph) affords an interesting facet of ancient and prehistoric India.

PAINTINGS

(Figure 15)

While a study of house types tells us about the most essential needs of man throughout the ages, the study of paintings found in caves, rock-shelters, and walls of houses, as early as five-six thousand B.C. through the early and mediaeval periods upto modern times, not only gives an insight into the artistic creations of man, but his beliefs, superstitions and other intangible aspects of life.

BURIALS

(Figure 16)

Usually bones of animals, birds and fish which the man might have eaten are found loose as kitchen midden on refuse. Human bones, if so found, may suggest various things, human sacrifice, cannibalism, or massacre. Usually, however, human bones are found in partial or complete burials. These again may

take various forms. For instance, at Langhnaj, North Gujarat we found several human skeletons in a crouched posture, bodies buried in sandy soil apparently without any cover, or unaccompanied by anything else. But in the Indus Civilization, these skeletons are usually laid straight on the floor, in a specially made burial pit, or a coffin of wood. And they are further accompanied by a large number of pots and pans, which give a vivid idea of the life of those times. In fact, the tombs of Egyptian Pharaohs are the best in this respect, for these illustrate in a small compass all that the king's palace had while he was living. A Pharaoh's tomb is Egyptian culture and civilization in miniature.

At Nevasa and elsewhere in the Deccan and Mysore burials are also found in earthen pots. These are the predecessors of later-day coffins, and of regular monuments devoted to the burial of the dead. These are often of a communal nature and do not contain complete human bodies, but only parts thereof, that is these are "fractional burials".

However, whatever be the form of the burial, it definitely indicates the religious belief of the people practising it, while the study of the bones and human anatomy gives most valuable data about the racial features of the people.

TERRACOTTA TOYS AND FIGURES

(Figures 11-11a, 17 and 18)

Other works of clay—like toys and figures are also important. These when found in sufficient numbers may give an index of the social, economic and religious nature of the people whose remains are being excavated.

In India, the classic instance is provided by the toys of the Indus or Harappa civilization. Just as later civilizations cannot compare with this earliest Indian civilization in civil organization and its pottery, so also in the variety and in the excellence of its toys, it is so far unsurpassable.

TOOLS AND WEAPONS

(Figure 19)

A study of tools and weapons, whether of stone, copper, bronze or iron, is equally instructive. For thousands of years during the Stone Age, the tools and weapons show little development. Specialization starts with a change in the mode of life—hunting and food-gathering—due to changing climatic conditions. Even then it takes hundreds of years for newer types of tools and weapons to appear. A settled way of life required tools with a more durable edge or point. And the man started grinding his tools. When the principle of compound tools, that is tools like the arrow, harpoon, sickle or a penknife made with a series of small sharp-edged stone blades was discovered, the older tools were given up.

The discovery of copper and its alloys like bronze and then iron revolutionized the life of the people. Still for a long time in countries like India the blade, whether it be of an axe, arrow-head or a spear, was hafted in a primitive way. Then came very effective improvements in the making of

the blade as well as the handle, which lasted until the discovery of gun powder. Slight improvements in the design as well as in the effective use of the tools and weapons were continuously made until the present age of automation.

Thus even if no writing is found an archaeologist simply by carefully classifying the collection of tools and weapons in a museum or from an excavation can reconstruct a rough outline of the various technological stages through which man has passed. Indeed this was what was done by Thomsen, a Scandinavian, nearly a century-and-half ago and thus laid the foundation of our thinking in terms of the three Ages—the Stone Age, Copper Age and Iron Age.

So much for the traditional archaeology, that is for objects which were cared for and used for interpreting the cultural history.

ASH, CHARCOAL, WOOD

Of late such trivial, relatively valueless and even despised things as ash, charcoal, buried soils, wood, dried faecal matter have begun to yield important information on several aspects of the past. Cigarette ash, for instance, is found mentioned in detective novels, and is known to supply clues about the culprit, a thief or a murderer. In the same way, ash when found in an archaeological excavation if examined by experts would tell us of the kind of fuel used by the inhabitants and in rare cases as in Germany, of such unusual happenings as the eruption of a volcano and the spread of its ash to distant places in the region. The charcoal when examined would tell us of the forest wealth in the past, and also the climatic conditions which enabled such forests to grow.

BURIED SOIL

(Figure 5)

Depending upon the nature of habitation excavations usually show a series of layers of brickbats, stones, earth, ash and charcoal. But in two of our excavations we met with fairly thick layers of clay and soil which we generally see on a river bank and in fields. At Kolhapur, just below the topmost layer of huge stones, we noticed a layer of sticky brown clay. This layer was thicker on the side of the Panchaganga river, but gradually became thinner further away from it and completely disappeared at a certain point. Very few objects were found in this sticky clay. The nature of its thickness, like a wedge—its constitution and contents told us, after sometime and a lot of reasoning, that this was not a man-made deposit. It indicated an unusual phenomenon at Kolhapur. A huge flood in the Panchaganga river which had submerged a part of the Kolhapur city, sometime back in the 16th-17th century, just before Aurangzeb camped there and built a wall of huge stones over it.

At Nevasa (Ahmednagar District) the occurrence of a black soil layer at a depth of nearly 20 ft. below the debris of five habitations, indicated the

existence of vegetation and forest-like conditions which had developed after the departure of the inhabitants who lived there in about 1,000 B.C.

The interpretation of the black soil has to be left to a scientist : in this case an archaeological chemist. But since the study relates to man, his absence or presence at Nevasa, the conditions—called environment—in which this happened, is important.

It is in this way that study of buried soils is helping us to know what has happened for hundreds of thousands of years since man appeared on this earth,—about the Ice Ages in Europe, America and in the Panjab or periods of heavy rain in Peninsular India.

BONES

Bones, either of man, animals and birds, are found in excavations and have been used for the last 100 years and more for learning about the types of man and animals which lived with the people whose remains are being unearched. This has become a routine affair, but of late the study of bones has been carried much further. Thus from a close study of bones, the disease which man suffered may be known. So also his blood group. In the case of animals, a detailed analysis of bones might tell us whether the animals were wild or domesticated, but also whether they were young or old when they were slaughtered. The bones can be further analysed for their nitrogen, uranium, and fluorine content and a relative time-table be prepared of the site. All these studies of bones belong to the sciences called palaeo-anatomy, palaeo-zoology or paleontology.

Two instances of how animal and bird bones are useful may be cited. The first is from our excavations at Langhnaj. Here we found a huge rib, which looked like an unstrung bow and an equally large shoulder blade. These were quite unusual for a camel, ox/cow or buffalo and animals which are today living in North Gujarat. Such large bones could be of an elephant or rhinoceros. Later Prof. Zeuner's study in England showed that the bones belonged to a rhinoceros. Now the story does not stop here. The rhinoceros normally flourishes in a marshy or swampy region, where rainfall is considerable. This is not the case in North Gujarat today. Thus the discovery of rhinoceros bones in the excavations at Langhnaj tells us that sometime in the past heavier rainfall fell in North Gujarat. In the same way an unusually long bone of a bird from a flood channel in Norfolk, England, on study, turned out to be that of a pelican which lived some 2,500 years ago and was different from the modern species of this bird.

Very often, from the nature of the teeth of human skeletons found in excavations, one can infer the nature of the diet which the men ate. If the teeth were highly ground, that is worn out, and not sharp, then it can be legitimately inferred that the food was considerably coarse. Just the reverse of modern city-bred man, whose teeth because of fine flour and highly cooked food will never be so much worn out as in the past.

COPROLITE

However, we can know not only about the quality of the diet, but also its content by one further study of fossil faecal matter found in excavations. This is particularly useful for times of which we have no record.

People in India think that the chillies (capsicum) must be indigenous to this country, because its use is so widespread here. No Indian meal can be thought of without them. A little study shows that this ingredient of daily use was introduced by the Portuguese in the 16th-17th century from South America. At Sierra Madre in southwestern Tamaulipas, Mexico, archaeologists have taken back its history to 6,000 B.C. by the chemical analysis of human dung found in excavations. Similar is the case of gourd pumpkin (*Cucurbita pepo.*), our white gourd (*Dudhi bhopla*) and French beans, *Phansi* (*Phaselous vulgaris*); the last vegetable we associate with our contact with the Europeans.

BURNT GRAIN

(Figure 20)

These are exceptional methods of learning about prehistoric diets and foods. Normally, however, past food habits are learned by the recovery of burnt raw grains or their impressions on pottery or fired clods of clay. It was thus known that the inhabitants of Sind and Panjab ate wheat, some 5,000 years ago, slightly later in Madhya Pradesh and about 3,000 years ago in Maharashtra. Thus the science of palaeo-botany has developed. It also tries to find out about the climatic conditions and vegetation by the study of pollen grains preserved in certain soils.

MARINE ARCHAEOLOGY

(Figure 21)

It has been mentioned above that the archaeologist's job is no longer confined to work on the land. He has "invaded" the sea as well.

When first begun some years ago, underwater exploration of shipwrecks was treasure-hunting. Divers were employed to search for buried cargo in the sea. In keeping with the general progress in archaeological aims and methods during the last few years, the aim today is not merely to bring forth buried treasures, but to prepare a geological analysis of the site and its marine environment, and to determine how long the work was done, and a full statement of the gross and net weight of objects lifted (if this represents the cargo of a ship).

Working in this way, ancient wine jars (amphorae), gold coins and ornaments, remains of ships, temples, and outlines of ancient harbours have been discovered in the Mediterranean near Turkey and Greece, off the coast of Canada and Ceylon and Egypt and Palestine. Again, as on land, the things are photographed, and plans of sites and objects drawn, and even attempts made to understand the stratification, that is, the position of the finds in relation to their

burial. Of course, this work requires close co-operation between archaeologists as well as divers and costly machinery of all sorts. Marine archaeology is, however, still in its infancy. Constant attempts are being made to improve its technique.

Thus things hitherto ignored by archaeologists and their colleagues—the scientists—are affording very interesting clues of the past.

An archaeologist, in fact, is a detective, and like the latter cannot afford to neglect anything, either on the surface or from the excavation. It is this aspect of the subject which at once makes it most fascinating, and an exacting discipline. It tests one's endurance and patience, develops skill, observation and resourcefulness. These coupled with some luck lead to success.

PATIENCE

If Dr. LEAKEY has succeeded in discovering the oldest and probably the largest number of human and animal fossils, it is because he and Mrs. Leakey have since 1931 worked in waterless, inhospitable parts of Africa, including Olduvai gorge. Their patience and endurance are now being rewarded by amazing finds : discovery of skulls and jaws which take the history of tool-making man back to 1.7 million years ago.

SKILL AND RESOURCEFULNESS

At Nevasa, we unearthed extensive stretches of lime-made floors. These were extremely delicate and could not be exposed even by the use of a penknife. Only by working with a long, and pointed babul thorn like a surgical instrument Dr. (Miss) ROSEN brought to light, bit by bit, a room nearly 16,00 sq. ft. in area. Such work takes days. In the same way mud floors of 3,000-4,000 years old huts at Navdatoli were revealed by Drs. DEO and ANSARI by the use of thorns only. Likewise, beautiful mosaic floor of Roman times at Verulamium, England, Sir Mortimer WHEELER exposed by endless patience and skill. The late Sir Leonard and Lady WOOLLEY brought to bear similar skill and patience when they two restored and recorded one by one scores of skeletons and precious objects lying in the Death Pit at Ur in Iraq (Mesopotamia). WOOLLEY'S resourcefulness in preserving the unbaked clay tablets by on-the-spot baking has become proverbial.

ADVENTURE

Finally, the human skeletons at Langhnaj would never have been found had Dr. (Mrs.) Iravati KARVE and I not persisted after weeks of disappointment in handling thousands of fragments of bones and stones. All this keeps an archaeologist always expectant. But above all, an archaeologist is with nature, like the explorer, geologist and engineer, and loves adventure. This to me is the greatest pleasure.

Archaeology is thus a discipline which strives to obtain knowledge about man and his past way of life by surface exploration, by excavation both on the

land and in the sea, lake or river. Mechanical as well as the latest scientific means are employed for this purpose.

COOPERATION BETWEEN HUMANITIES AND SCIENCES

Once the things are found follows interpretation. In this again assistance or co-operation from sciences as well as humanities is sought (see chart). For the aim is the total picture of man in the past. There is joy or delight not only in having this knowledge, but in its very pursuit.

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